

Making Cancer History®

THE UNIVERSITY OF TEXAS
MD Anderson
~~Cancer~~ Center

Adaptive SBRT for Liver and Pancreas Patients

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Speakers: Josh Niedzielski, MD Anderson

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Institute**

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Pancreas & Liver Cancer



Incidence/epidemiology

- Relatively low incidence
- High mortality



Treatment with SBRT

- Apparent improved efficacy over standard fractionation
- Local control more important with improved systemic treatments
- More convenient and less disruptive to other treatments
- Move pancreas patient from borderline resectable to resectable or a liver patient to being a transplant candidate

Estimated New Cases

			Males	Females			
Prostate	248,530	26%			Breast	281,550	30%
Lung & bronchus	119,100	12%			Lung & bronchus	116,660	13%
Colon & rectum	79,520	8%			Colon & rectum	69,980	8%
Urinary bladder	64,280	7%			Uterine corpus	66,570	7%
Melanoma of the skin	62,260	6%			Melanoma of the skin	43,850	5%
Kidney & renal pelvis	48,780	5%			Non-Hodgkin lymphoma	35,930	4%
Non-Hodgkin lymphoma	45,630	5%			Thyroid	22,130	3%
Oral cavity & pharynx	38,800	4%			Pancreas	28,480	3%
Leukemia	35,530	4%			Kidney & renal pelvis	27,300	3%
Pancreas	31,950	3%			Leukemia	25,560	3%
All Sites	970,250	100%			All Sites	927,910	100%

Estimated Deaths

			Males	Females			
Lung & bronchus	69,410	22%			Lung & bronchus	62,470	22%
Prostate	34,130	11%			Breast	43,600	15%
Colon & rectum	28,520	9%			Colon & rectum	24,460	8%
Pancreas	25,270	8%			Pancreas	22,950	8%
Liver & intrahepatic bile duct	20,300	6%			Ovary	22,950	5%
Leukemia	13,900	4%			Uterine corpus	12,940	4%
Esophagus	12,410	4%			Liver & intrahepatic bile duct	9,930	3%
Urinary bladder	12,260	4%			Leukemia	9,760	3%
Non-Hodgkin lymphoma	12,170	4%			Non-Hodgkin lymphoma	8,550	3%
Brain & other nervous system	10,500	3%			Brain & other nervous system	8,100	3%
All Sites	319,420	100%			All Sites	289,150	100%

Adapted from Seigel et al. 2021





Challenges of Liver and Pancreas SBRT

Radiosensitive organs at risk (OARs) close to target

Inter and intra-fractional tumor and OAR motion

Visibility of the tumor and OARs





Prescriptions (HyTEC)

Pancreas

36 Gy in 3 fractions (~43 Gy in 5)

- 1 year LC w/o surgery of 86%
- BED 79 Gy

24 Gy in 3 fractions (~28 Gy in 5)

- 1 year LC w/o surgery <70%
- BED 43 Gy

Liver

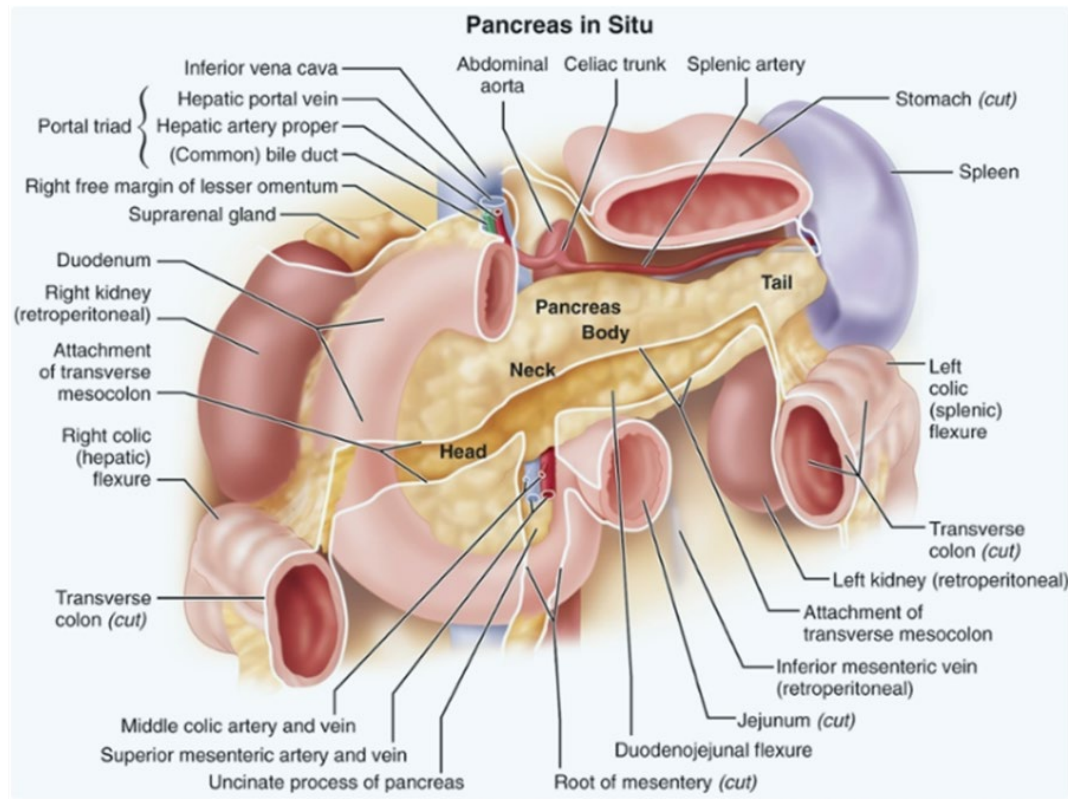
Primary liver

- No significant difference seen for BEDs 60-180 Gy

Liver metastases

- Significant improvement (93% vs 65% 3 year local control) with **BED > 100 Gy** (e.g. 50 Gy in 5)

Proximity of Organs at Risk



Adapted from Gunderson & Tepper, Clinical Radiation Oncology 5th ed.

**Stomach/duodenum/bowel constraints
(5 fraction SBRT at MD Anderson)**

Dmax < 40 Gy

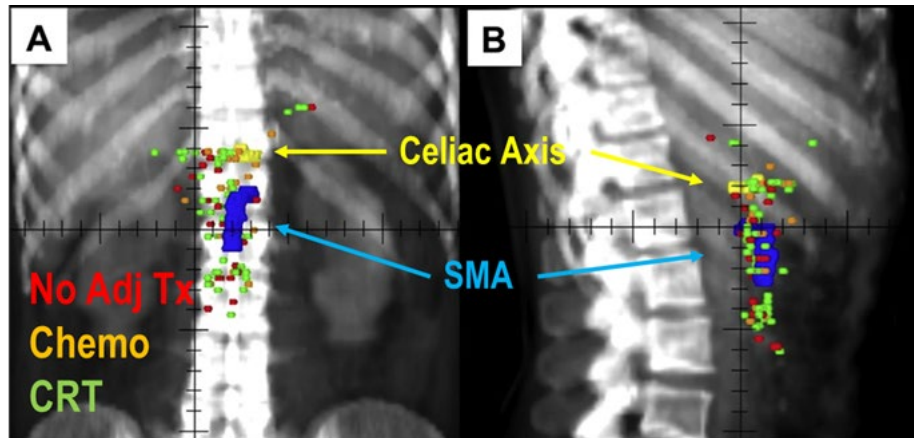
V35 Gy < 1 cc



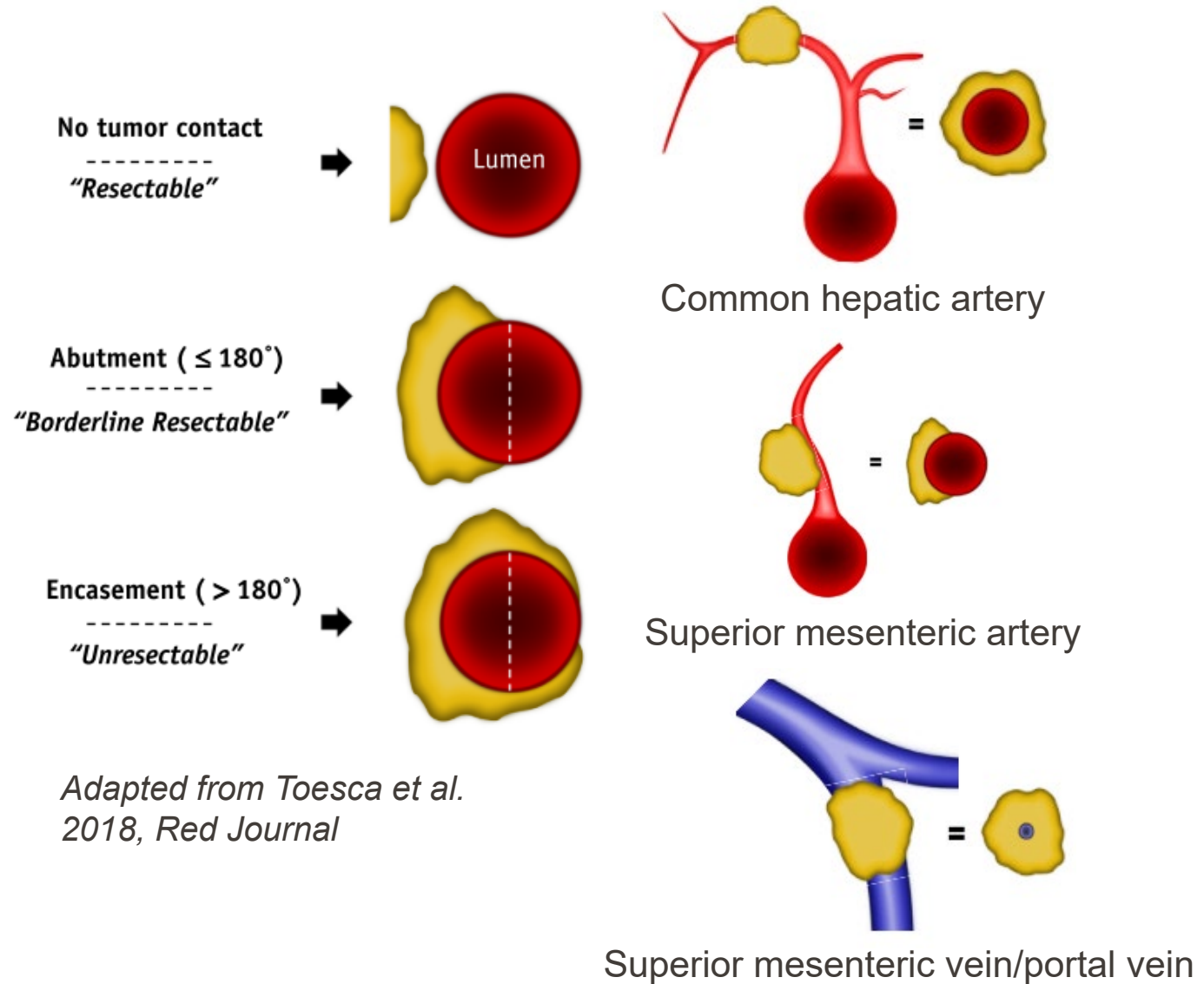
Pancreatic Cancer Targets

Borderline resectable primarily concerned with vessels

- Limitation in surgery
- 90% of recurrences within ~2 cm of celiac axis and superior mesenteric artery (SMA)

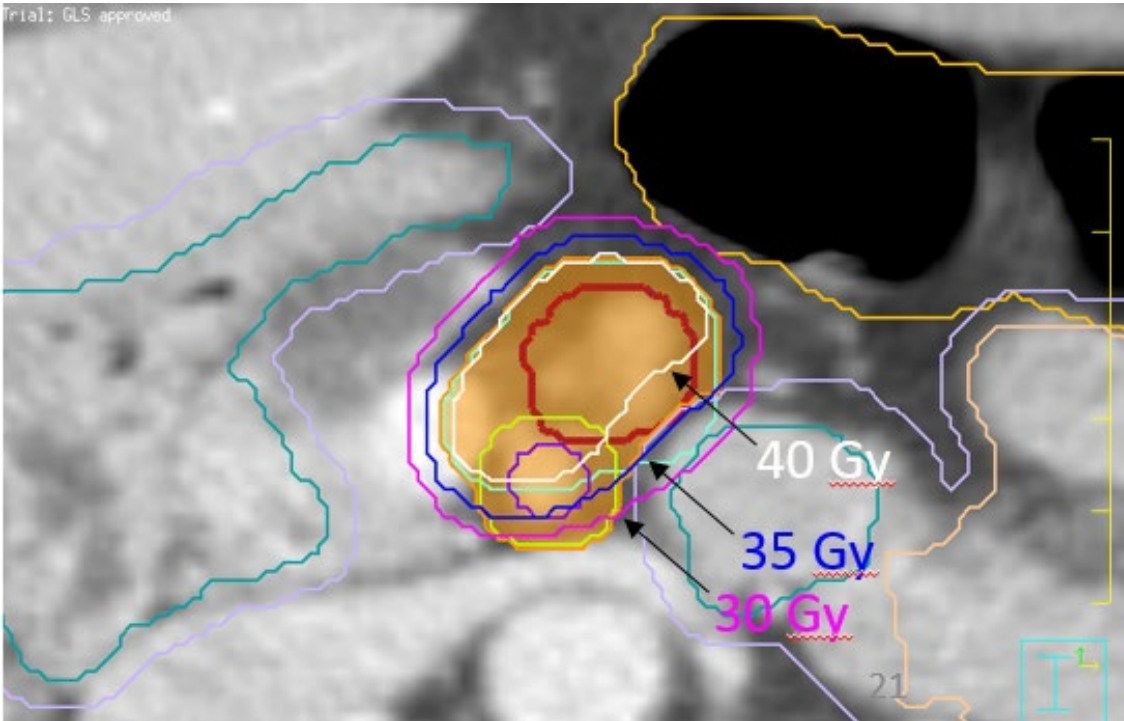
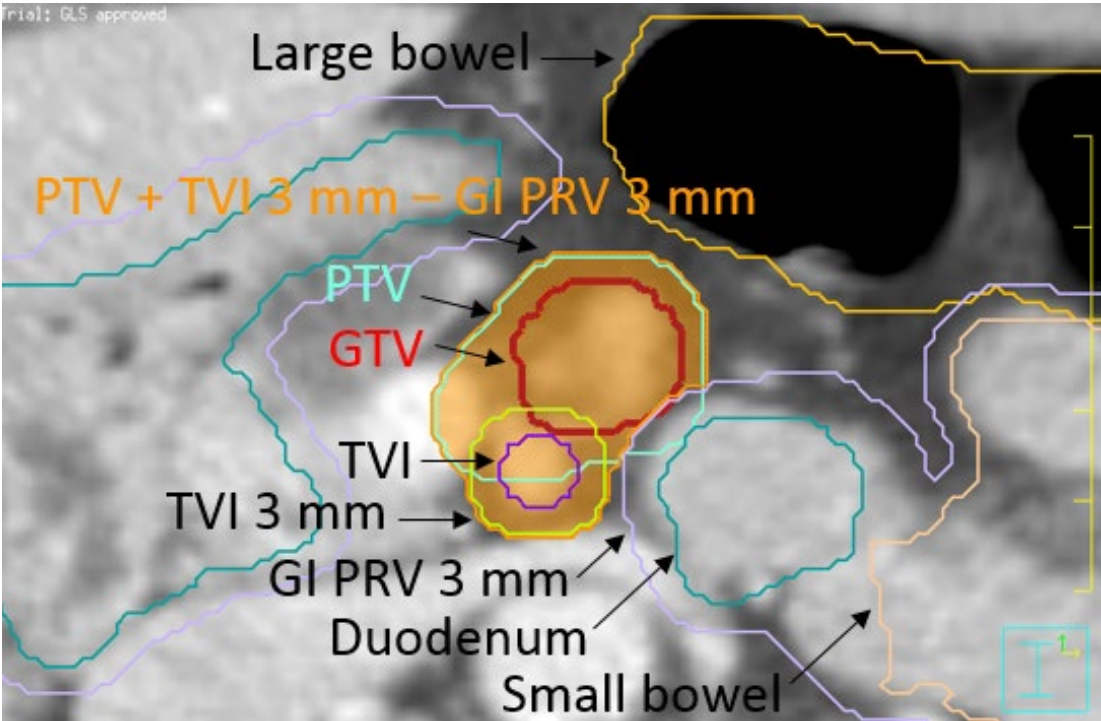


Adapted from Dholakia et al. 2013, Red Journal





Proximity of Organs at Risk



GTV: Gross tumor volume

PRV: Planning organ at risk volume

PTV: Planning target volume

TVI: Tumor vessel interface



Interfractional motion



Causes

- Bowel/stomach filling
- Gas
- Patient setup

Problems

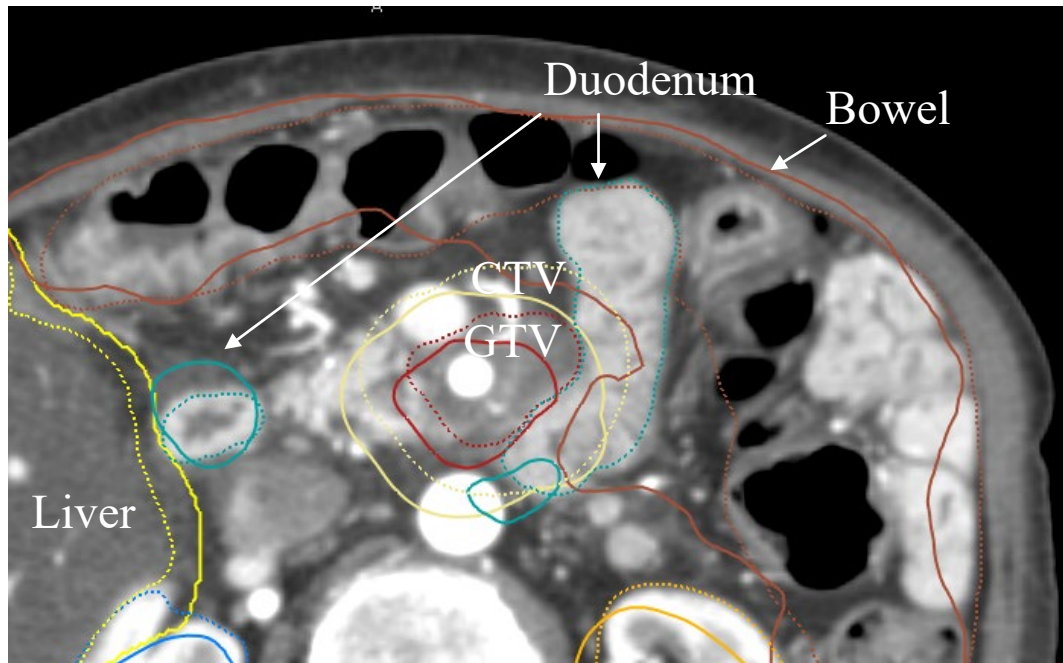
- Missed target
- OARs move into high dose region
- Difference in dose distribution

Solutions

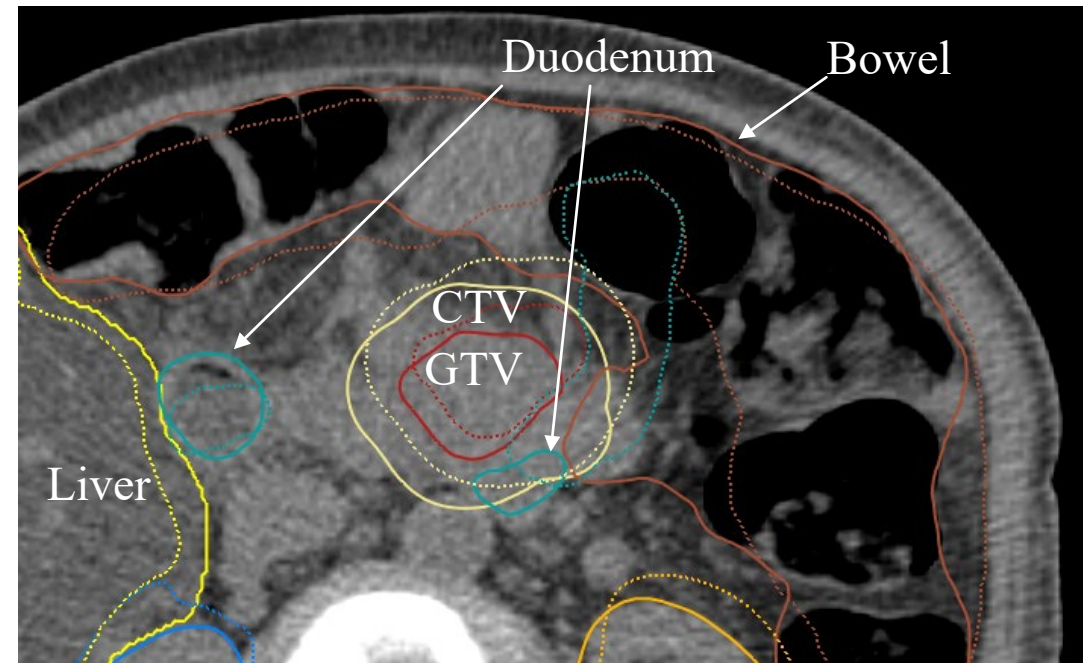
- NPO/gas management
- High quality IGRT
- Adaptive planning



Interfractional Motion



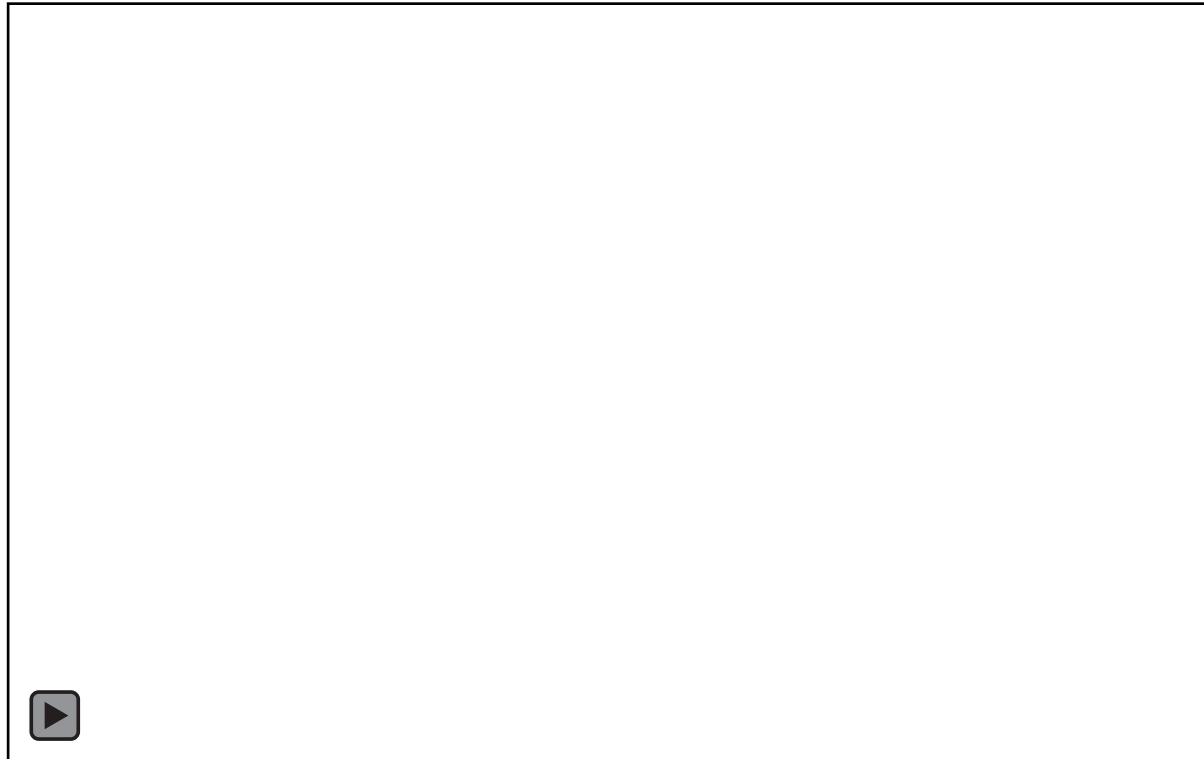
Simulation CT
(original contours dotted lines)



Adaptive replan using daily CT
(new contours solid lines)



Intrafractional Motion



Causes

- Breathing

Problems

- Missed target
- Increased area of OAR irradiation

Solutions

- 4DCT
- Breath hold
- Compression
- Etc...



Tumor and OAR Visualization

CBCT image quality and artifacts



Free Breathing



Breath hold with fiducials



Goals of this Session

Understand the challenges associated with pancreas and liver SBRT and the role of high quality volumetric IGRT and adaptive planning in addressing them

Josh Niedzielski

18 min + 2 min (Q&A): Importance of Daily Adaptation for the Management of Liver and Pancreas Patients Receiving SBRT

Kathryn Mittauer

18 min + 2 min (Q&A): MR Guidance and Online Adaptation of Liver and Pancreas Patients

10 min **Q&A**